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Abstract

THE TIME-OF-FLIGHT METHOD FOR NEUTRON CRYSTAL STRUCTURE INVESTIGATIONS AND ITS POSSIBILITIES IN CONNECTION WITH VERY HIGH FLUX REACTORS

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A new method for neutron structure investigations of powdered crystals using the time-of-flight technique is desoribed. In this method a pulsed neutron beam is scattered on a powdered crystal and the intensity of the scattered neutrons at a fixed angle is measured by means of neutron counters connected to a multichannel time analyser. As a result an intensity vs wavelength curve is obtained. The peaks are indexed in the usual manner and the structure factors are obtained using a formula for the integrated intensity especially derived for this type of experiment. According to this formula the integrated intensity is proportional to the fourth power of the wavelength, which favours diffraction peaks for long wavelength so that peaks corresponding to 4 - 5 A° are also clearly visible. This is especially suitable for studies of crystals with large unit cells and when a very high resolution is needed. Additional advantages of this method are: no higher order contaminations and an appreciable /more than an order of magnitude/ shortening of the exposure time as compared with the conventional method.

The feasibility of the method has been proved experimentally at the "Ewa" reactor in Świerk, Poland /using a chopper/ and at the pulsed reactor IBR in the Joint Institute of Nuclear Research in Dubna, USSR /with a very high flux in the pulse/ using powdered samples of Pb, Al, Si, Zn, ZnO.

In this method one can also apply to the crystalline sample an external field /e.g. an electric field/ pulsed with the same frequency as the neutrons but shifted in time. In this way the study of transient effects /relaxation phenomena/ with relaxation times from 0,1 msec to 200 mseo and more sthould be possible. This seems to be the most interesting feature of the method. Experi-

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x/ The names of additional co-authors will be submitted on a later date.

ments along these lines are under way. For this kind of experiments a very high resolution is essential and this can be obtained using either high intensity pulsed sources or very high flux reactors and chopping the beam. Using this method with such reactors it should be also possible to obtain a diffraction pattern in a very short time /of an order of several minutes/ which in turn should enable the study of transient phenomena with relaxation times greater than several minutes.